INSTALLATION AND OPERATION MANUAL

HSF-1, HSF-2

Fiber Optic Teleprotection Interface Modules

Megaplex-2100/2104 Version 12, Megaplex-4100 Ver. 1.6

RAD
data communications
The Access Company

HSF-1, HSF-2

Fiber Optic Teleprotection Interface Modules

Megaplex-2100/2104 Version 12, Megaplex-4100 Ver. 1.6

Installation and Operation Manual

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Quick Start Guide

If you are familiar with the HSF modules, use this guide to prepare them for operation.

Warning

For your safety:

- Do not look directly into optical connectors while the HSF module is operating.
- Do not attempt to adjust the laser drive current.
- The use of optical instruments with this product will increase eye hazard.
- Use of controls or adjustment or performing procedures other than those specified herein may result in hazardous radiation exposure.

1. Connecting the Cables

Insert the module in the assigned I/O slot, and then connect the prescribed cables to the module connectors as follows:

- Transmit fiber: connect to the corresponding TX connector
- Receive fiber: connect to the corresponding RX connector.

2. Configuration Procedure

Configuring the HSF Modules

➤ To configure the desired HSF-1, HSF-2 port in the MP-2100/2104 chassis:

Use the command:

```
DEF CH SS CC
```

where **ss** is the slot number, and **cc** is the port number (1 or 2).

➤ To configure the desired HSF-1, HSF-2 port in the MP-4100 chassis:

Use the **Configuration>Physical Ports>I/O** screen.

Configuration parameters and the range of values are listed in the following table.

Parameter	Range of Values
Connect*	YES **NO**
Admin Status**	UP **DOWN**
Rate	**1 Ts** to **10 Ts**
ML Slot*	**IO-1** up to the maximum supported by the chassis
ML Channel*	**EX1** up to the maximum supported by the selected main link module
Destination Slot**	**CL, IO-1** to **IO-10**
Destination Port**	1 to 8 for external ports 1 to 63 (1 to 84) for internal (virtual) PDH ports **NONE**

* MP-2100/2104 only

** MP-4100 only

Configuring the Main Link Port

Configure the port of the main link module to which the HSF payload is routed using the command **DEF CH SS CC**, where **SS** is the main link slot number and **CC** is the main link port number.

To comply with the requirements of the IEEE PC37.94 standard draft, the Megaplex main link port carrying the HSF payload must be configured with DATA OOS sequence=**FF.**

3. Timeslot Routing

Configure the HSF module timeslot routing, using the command **DEF TS.**

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Chapter 1
Introduction

1.1 Overview

Purpose and Main Features

This manual describes the technical characteristics, applications, installation and operation of the HSF-1 and HSF-2 teleprotection interface modules for the Megaplex modular E1/T1 multiplexer systems. The modules have single or dual fiber optic interface, which provides a secure link in hazardous or hostile environments, increases the maximum connection range, and provides immunity against electrical interference and protection against the deleterious effects of ground loops.

The function of the modules is to interface between the Megaplex and an external fiber optic link complying with the requirements of the IEEE PC37.94 standard draft for $n \times 64$ kbps fiber optic interfaces to teleprotection equipment. This enables the teleprotection equipment to use the advanced transport capabilities offered by Megaplex equipment. The HSF modules support a teleprotection traffic payload in the range of 64 to 640 kbps per port (that is, n = 1 to 10).

The fiber optic link operates at a line rate of 2.048 Mbps and uses the framing mode specified in the IEEE PC37.94 standard draft (this framing is based on the G.732N framing for E1 links).

The modules have one or two optical ports, operating at a nominal wavelength of 850 mm. The ports are terminated in two ST connectors, for connection to standard multimode fibers.

Product Options

The HSF modules are available in a single- or dual interface versions and are called HSF-1 and HSF-2, respectively. HSF-1 is supported by the Megaplex-2100 and Megaplex-2104 chassis only, while HSF-2 is also supported by Megaplex-4100.

Note *In this manual, the generic term **Megaplex** is used when the information is applicable to all the Megaplex chassis and the term **HSF** is used when the information is applicable to both the HSF-1 and HSF-2 versions. The complete equipment designation is used only for information applicable to a specific equipment version.*

Application Considerations

The HSF modules can be installed in any I/O slot. The number of HSF modules actually installed in a Megaplex can be selected in accordance with the number of fiber optic links required by the specific user's application.

In accordance with the IEEE PC37.94 standard draft, each 64 kbps teleprotection traffic payload carried by the HSF module occupies two timeslots on the HSF optical link, and is processed by the HSF module for transport in a single 64 kbps main link timeslot.

A typical HSF-1 application is shown in *Figure 1-1.*

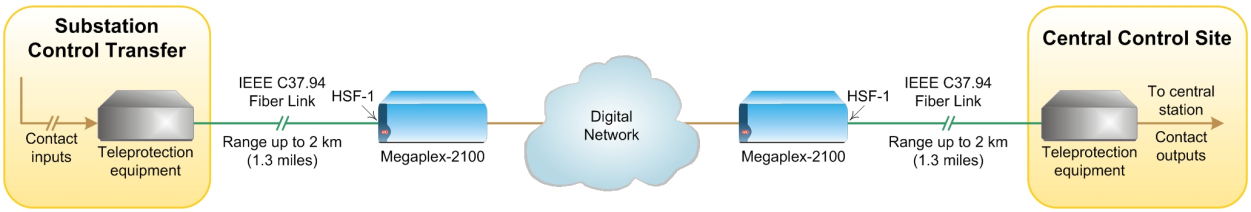


Figure 1-1. Typical HSF-1 Application

The following configuration restrictions apply:

- HSF payload timeslots must always be defined as data timeslots.
- To comply with the requirements of the IEEE PC37.94 standard draft, the Megaplex main link port carrying the HSF payload must be configured with DATA OOS sequence=**FF**.
- The equipment connected to the remote end of the link should use loopback timing (i.e., its timing must be locked to the Megaplex nodal timing).

1.2 Physical Description

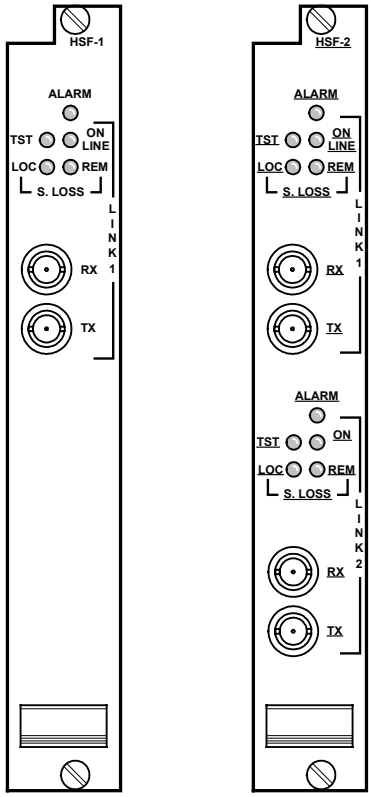
HSF-1 and HSF-2 are 4U-high modules, which occupy one module slot in the Megaplex chassis. All their functions are configured by software.

The panels of the HSF-1 and HSF-2 modules are shown in *Figure 1-2*. *Table 1-1* explains the functions of the indicators located on the module panel.

Each port has two optical connectors, designated TX (transmit output) and RX (receive input).

Table 1-1. HSF Indicators

Indicator	Description
ALARM	Lights when a fault has been detected in the module
ON LINE	Lights when the module is operating properly and is active. Off when the module is defective, or is not connected to a TDM bus
LOC S. LOSS	Lights when the local module has lost frame synchronization
REM S. LOSS	Lights when a loss-of-frame synchronization indication is received by the module from the equipment connected to the remote end of the fiber-optic link
TST	Not used



HSF-1 *HSF-2*

Figure 1-2. HSF Module Panels

1.3 Functional Description

Background Information

The frame structure used by the HSF external port is in accordance with the IEEE PC37.94 standard draft. The frame structure specified in this standard draft is similar to the 2.048 Mbps frame structure of ITU-T Rec. G.704 and the no-signaling frame structure (G.732N) of ITU-T Rec. G.732. The main differences are as follows:

- Timeslots 0 to 7 are used for the teleprotection link overhead, and therefore the first payload timeslot is 8.
- The payload data encoding method uses two teleprotection link bits to represent each teleprotection payload bit. Therefore, two link timeslots (128 kbps) are needed for each 64 kbps teleprotection channel.

  For example, when the teleprotection payload rate is 64 kbps, the teleprotection link rate is 128 kbps and used timeslots are 8 and 9. The other payload timeslots, that is, 10 to 31, carry alternating "1" and "0". However, within the HSF module the data received from the telecommunication equipment is decoded and the contents of each pair of timeslots is restored

to 64 kbps before being routed to a Megaplex TDM bus. Therefore, in this example, only one timeslot is transferred to the TDM bus.

The reverse process occurs in the HSF transmit path: each timeslot received from a TDM bus is encoded and inserted in two consecutive timeslots (starting with 8).

Functional Block Diagram

Figure 1-3 shows the functional block diagram of the HSF-2 module. The HSF-1 block diagram is similar, the only difference being in that only one link is available.

The HSF module includes the following main subsystems:

- **TDM bus interfaces**: four independent TDM bus interfaces, one for each Megaplex TDM bus.
- **Routing matrix**: controls the routing of the payload timeslots between the TDM bus interfaces and the HSF interface.

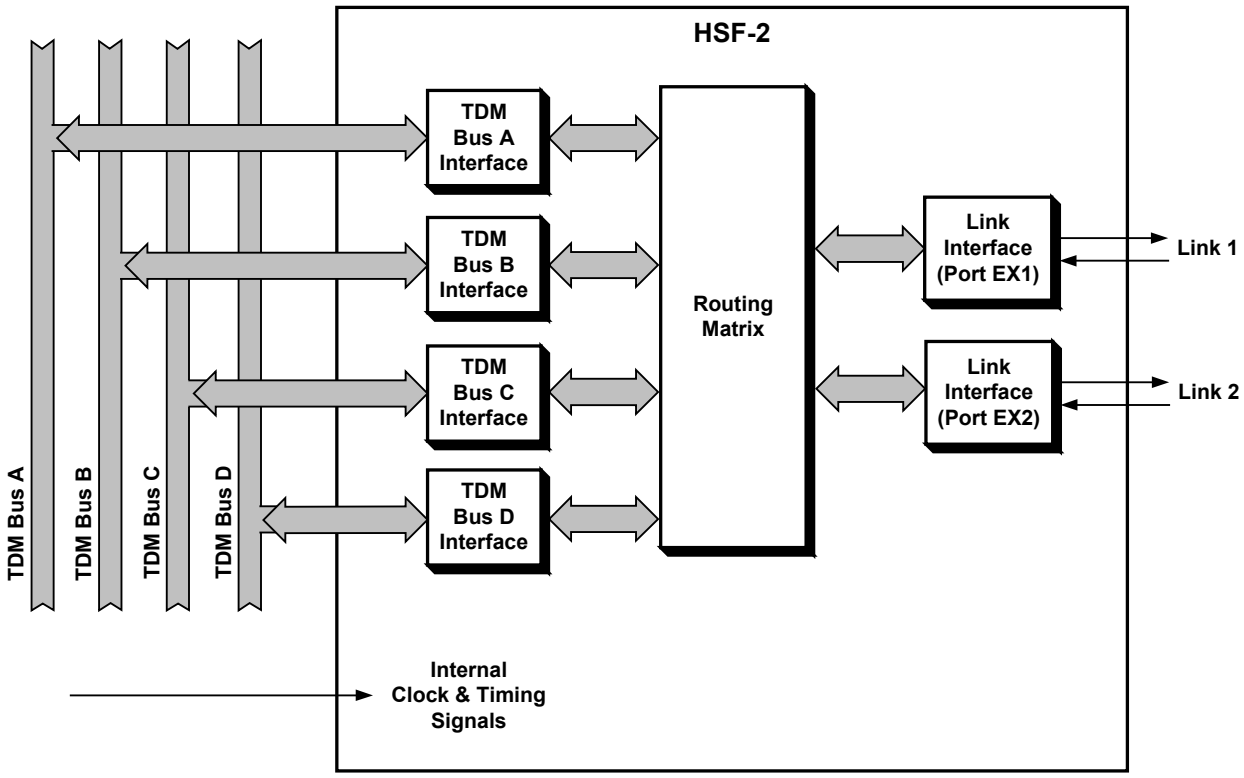


Figure 1-3. HSF-2 Functional Block Diagram

- **Link interface:**
  - The transmit path of the interface performs the following main functions:
    - Fills constant data in accordance with the IEEE PC37.94 standard draft in the timeslots that do not carry payload.
    - Generates frames in accordance with the IEEE PC37.94 standard draft and inserts the processed data stream in the appropriate timeslots of the transmit frame.
    - Prepares the resulting data stream, having a line rate of 2.048 Mbps, for transmission through the HSF fiber-optic link interface.
  - The receive path performs the following main functions:
    - Recovers the receive signal from the optical signal received from the teleprotection equipment.
    - Synchronizes to the incoming signal frame, and retrieves the payload timeslots and decodes the received payload.
    - Transfers the retrieved payload timeslots to the TDM bus (through the routing matrix).
- **Timing subsystem**: generates the internal clock and timing signals required by the HSF link transmit path. These signals are locked to the Megaplex nodal timing.

Link Interface Characteristics

The HSF modules have single or dual optical interface for operation over multimode fibers terminated in a ST connector. The nominal wavelength is 850 mm.

The fiber optic interface offers high performance and has a wide dynamic range, which ensures that the receiver will not saturate even when using short fiber optic cables (saturation is caused when the optical power applied to the receiver exceeds its maximum allowed input power, and results in very high bit error rates).

Timing

The HSF transmit path timing is derived from the nodal clock used by the Megaplex.

The nodal clock source can be selected in accordance with system requirements, as explained in the corresponding *Megaplex Installation and Operation Manual*. The HSF module cannot be selected as timing source.

The receive path of the HSF optical port uses the clock signal recovered from the corresponding received line signal. Therefore, the user's teleprotection equipment should use loopback timing, that is, its link transmit clock should be locked to the receive clock derived from the receive data of the same port.

Alarm Indications

The HSF module provides the following alarm indications:

- **To the local teleprotection equipment**: in case of local loss of frame synchronization on the corresponding main link port, the HSF module inserts a 1010... sequence in the timeslots sent to the teleprotection equipment.
- **To the remote equipment**: in case a local loss of frame synchronization or loss of input signal occurs on the receive path of the HSF module, the module sends a stream of "1" to the TDM bus toward the corresponding main link port (equivalent to an FF out-of-service (OOS) sequence).

Diagnostics

The HSF module panel includes indicators that display the status of the link interface (loss of local and remote synchronization), and the presence of alarms in the module.

1.4 Technical Specifications

Number of Links	1 or 2	
Payload Rate	$n \times 64$ kbps per port, where n = 1 to 10 (64 to 640 kbps)	
Megaplex Support	*HSF-1*	MP-2100, MP-2104
	HSF-2	MP-2100, MP-2104, MP-4100
Line Interface Characteristics	*Nominal Bit Rate*	2.048 Mbps
	Wavelength	850 nm
	Fiber Type	62.5/125 μm multimode
	Transmitter Type	VSCEL
	Power Coupled into Fiber	-19 to –11 dBm (-15 dBm typical)
	Receiver Sensitivity	-32 dBm
	Optical Budget	13 dB
	Maximum Receiver Input Power	-11 dBm
	Receiver Dynamic Range	21 dB
	Typical Range	2 km (with 6.8 dB margin)
	Frame	IEEE PC37.94 draft
	Connectors	ST

Timing	*Internal Oscillator*	±30 ppm
Indicators	*Module*	Alarm
	Link Interface	• On-line • Local sync loss • Remote sync loss
Configuration		Programmable via Megaplex management system

Chapter 2

Installation and Operation

2.1 Introduction

This chapter provides installation, configuration and operation instructions for the HSF-1 and HSF-2 modules.

The information presented in this chapter supplements the Megaplex installation, configuration and operation instructions contained in the corresponding *Megaplex Installation and Operation Manual*.

Warning

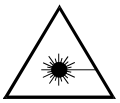
Before performing any internal settings, adjustment, maintenance, or repairs, first disconnect all the cables from the module, and then remove the module from the Megaplex enclosure.
No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by a skilled technician who is aware of the hazards involved.
Always observe standard safety precautions during installation, operation, and maintenance of this product.

Caution

The HSF modules contain components sensitive to electrostatic discharge (ESD). To prevent ESD damage, always hold the module by its sides, and do not touch the module components or connectors.

HSF modules comply with laser product performance standards set by government agencies for Class 1 laser products. The modules do not emit hazardous light, and the beam is totally enclosed during all operating modes of customer operation and maintenance.

HSF modules are shipped with protective covers installed on all the optical connectors. Keep the covers for reuse, to reinstall the cover over the optical connector as soon as the optical cable is disconnected.



Warning

For your safety:

- Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the optical transmitter.
- Do not use broken or unterminated fiber-optic cables/connectors.
- Do not look straight at the laser beam, and do not look directly into the optical connectors while the module is operating.
- Do not attempt to adjust the laser drive current.
- The use of optical instruments with this product will increase eye hazard.
- Use of controls or adjustment or performing procedures other than those specified herein may result in hazardous radiation exposure.

ATTENTION: The laser beam may be invisible!

2.2 Installing the Module in the Chassis

The HSF modules can be installed in an operating chassis (hot insertion). Avoid looking directly into the optical connectors.

For general installation procedures and safety instructions, refer to the corresponding *Megaplex Installation and Operation Manual.*

Insert the HSF module in the prescribed I/O slot and fasten it with its two screws.

2.3 Connecting the Cables

Before starting, refer to the installation plan to determine the fiber-optic cables intended for connection to the HSF module.

Connect the prescribed cables to the following connectors on the module panel:

- Connect the transmit cable to the TX connector
- Connect the receive cable to the RX connector.

Before connecting, clean the optical connectors using an approved solvent, and dry thoroughly using optical tissue. Avoid sharp bends and twisting of the fiber optic cables.

2.4 Normal Indications

Module Status Indication

When the link connected to the HSF module is operational, its ALARM indicator must be off.

Link Status Indications

The normal indications for an operational link interface are as follows:

- The ON-LINE indicator of an active link must light steadily.
- If the other communication equipment on the link is not yet operative, the corresponding LOC S. LOSS and/or REM S. LOSS indicator may light. These indicators must turn off as soon as the link with the remote equipment is established.

Chapter 3

Configuration

This chapter provides configuration information for HSF modules installed in the Megaplex-2100/2104 or Megaplex-4100 chassis. For general instructions and additional configuration procedures, refer to *Megaplex-2100/2104 Installation and Operation Manual* and *Megaplex-4100 Installation and Operation Manual,* respectively.

The configuration is performed by means of the management system used to control the Megaplex unit:

- Supervision terminal or Telnet – refer to the *Megaplex-2100/2104 or Megaplex-4100 Installation and Operation Manual* for instructions.
- Web browser – refer to the *Megaplex-4100 Installation and Operation Manual* for instructions.
- Network management system, e.g., the RADview network management system – refer to the *RADview User's Manual* for instructions.

3.1 Configuration Sequence for the MP-2100/2104 Chassis

➤ **To configure an HSF-1, HSF-2 module and put it into service:**

1. Add an HSF-1, HSF-2 module not yet installed in the Megaplex-2100/2104 chassis to the database. This allows preconfiguring the module parameters, so that the module will immediately start operating in the desired mode as soon as it is installed in the enclosure. For the supervision terminal, use the DEF SYS command.
2. Configure the HSF-1, HSF-2 channel parameters:
   - To define the parameters of all the module channels on the supervision terminal, type the command:

     DEF CH SS *

   - To define the parameters of a desired channel on the supervision terminal, type the command:

     DEF CH SS CC

   where SS is the slot number, and CC is the channel number (1 or 2). For the parameter description, see *Table 3-1*.
3. Assign timeslots as described in *Section 3.4*.

Note

Make sure to plan ahead the configuration sequence, because Megaplex-2100/2104 databases can be updated only after correctly completing the configuration activities: any sanity error will prevent saving the changes to the database being modified.

3.2 Configuration Sequence for the MP-4100 Chassis

➤ To configure an HSF-2 module and put it into service:

1. Add an HSF-2 module not yet installed in the Megaplex-4100 chassis to the database. This allows preconfiguring the module parameters, so that the module will immediately start operating in the desired mode as soon as it is installed in the enclosure.

   For the supervision terminal, use the **Configuration>System>Card Type** screen.

2. Configure the CL or M8E1/M8T1/M8SL module port parameters (depending on the HSF-2 module application). For the configuration procedure, refer to the appropriate Installation and Operation Manual.
3. Configure the HSF-2 port parameters. For the supervision terminal, use the **Configuration>Physical Ports>I/O** screen.
4. Configure the timeslot assignment of each module port, using the **Configuration>System>TS Assignment** screen.

Note

Make sure to plan ahead the configuration sequence, because Megaplex-4100 databases can be updated only after correctly completing the configuration activities: any sanity error will prevent saving the changes to the database being modified.

3.3 Configuration Parameters

Each HSF-1, HSF-2 port can be independently configured in accordance with the system requirements.

Table 3-1 explains the programmable parameters of the HSF-1, HSF-2 module and their ranges of values.

Table 3-1. Port Parameters

Parameter	Function	Values
Connect (MP-2100/2104 only)	Determines whether the channel is connected to the internal TDM buses of the Megaplex chassis	**NO** The channel is disconnected. You can still program the desired parameters, so the channel will be ready to operate when needed. **YES** The channel is connected to a legacy main link port, and can carry traffic. **Default: NO**
Admin Status (MP-4100 only)	Used to enable/disable the flow of traffic through the selected port	**UP** The flow of traffic is enabled. **DOWN** The flow of traffic is disabled. This state should be selected as long as the port configuration has not yet been completed, or when it is necessary to stop traffic flow through the port. **Default: DOWN**
Rate	Specifies the port rate in timeslots	**1 Ts** to **10 Ts** **Default: 1 Ts**
ML Slot (MP-2100/2104 only)	Selects the I/O slot number of the destination main link module	**Default: IO-1**
ML Channel (MP-2100/2104 only)	Selects the number of the main link port on the selected destination main link module	**Default: EX1**
Destination Slot (MP-4100 only)	Specifies the module (I/O slot) to which the data stream handled by the port is routed.	The available selections are the CL module installed in the chassis, and I/O modules IO-1 to IO-10.
Destination Port (MP-4100 only)	Specifies the port to which the data stream handled by the port is routed.	The available selections are 1 to 8 for external ports, or 1 to 63 (1 to 84) for internal (virtual) ports (actual range depends on the destination module).

3.4 Assigning Timeslots

After performing the configuration of the individual module channels, it is necessary to assign the uplink bandwidth to each connected port.

- For the module installed in the MP-2100/2104 chassis, use the **DEF TS** command to assign timeslots as explained in the *Megaplex-2100/2104 Installation and Operation Manual*.
- For the module installed in the MP-4100 chassis, use the **Configuration>System>TS Assignment** screen.

Note *As a result of the IEEE PC37.94 requirements, the following configuration guidelines apply:*

- *HSF payload timeslots must always be defined as data timeslots.*
- *To comply with the requirements of the IEEE PC37.94 standard draft, the Megaplex main link port carrying the HSF payload must be configured with DATA OOS sequence=**FF**.*

3.5 Displaying Status and Configuration Information

The Megaplex-2100/2104 user can read the HSF-1, HSF-2 status and configuration information using the **DSP ST CH** command. For a general description of this command, refer to *Appendix F* of the *Megaplex-2100/2104 Installation and Operation Manual*.

The **DSP ST CH** command includes two sections:

- **Hardware Config/Status**: displays the displays the optical interface type (nominal wavelength – 850 nm, Laser (VCSEL) transmitter, ST connector).
- **Software Configuration**: displays a data form similar to that displayed by the **DEF CH** command, showing the current configuration of each channel. For a description of the displayed parameters, refer to *Table 3-1*.

The Megaplex-4100 user can read the configuration on every port of the I/O modules using the **Configuration>Physical Ports>I/O** menu. For a general description of these menus, refer to *Chapter 4* of the *Megaplex-4100 Installation and Operation Manual*.

Chapter 4

Troubleshooting and Diagnostics

The HSF modules do not support loopbacks and tests.

Caution The activation of a loopback or test on the HSF link will disconnect the external link, therefore this is not allowed under any circumstances.

For a description of the alarm and configuration ("sanity") error messages generated by HSF module, refer to *Appendix B* of the *Megaplex-2100/2104 Installation and Operation Manual* or *Chapter 5* of the *Megaplex-4100 Installation and Operation Manual*.

4.1 Troubleshooting Instructions

In case a problem occurs, check the displayed alarm messages and refer to the corresponding *Megaplex Installation and Operation Manual* for their interpretation.

If the problem is related to the HSF module, pull the module out wait about one minute. After reinserting the module, read the power-up test results and replace the module if any fault is reported.

If after collecting all the relevant information, the problem appears to be related to the operation of the main link serving the HSF module, perform the actions listed below, until the problem is corrected:

- If the fault occurs after configuration changes or on the first time the module is operated, check for correct configuration in accordance with *Chapter 3.*
- If traffic to other modules is served by the same main link port as used by the HSF module, troubleshoot the main link module:
  - Activate the local loopback on the corresponding main link port. If the S. LOSS LOC indicator of the local main link port turns OFF while the loop is connected, the problem is external. Check cable connections, and the transmission equipment providing the link to the remote Megaplex unit.
  - You can rapidly check the link to the remote Megaplex unit by activating the remote main link loopback at the remote unit. If the corresponding link operates OK, the S. LOSS LOC indicator of the corresponding local main link turns OFF.

If the problem persists, the main link module is probably defective and must be replaced.

4.2 Technical Support

Technical support for this product can be obtained from the local distributor from whom it was purchased.

For further information, please contact the RAD distributor nearest you or one of RAD's offices worldwide. This information can be found at www.rad.com (offices – About RAD › Worldwide Offices; distributors – Where to Buy › End Users).

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Customer Response Form

RAD Data Communications would like your help in improving its product documentation. Please complete and return this form by mail or by fax or send us an e-mail with your comments.

Thank you for your assistance!

Manual Name: HSF-1, HSF-2

Publication Number: 764-245-02/08

Please grade the manual according to the following factors:

	Excellent	*Good*	*Fair*	*Poor*	*Very Poor*
Installation instructions	❒	❒	❒	❒	❒
Operating instructions	❒	❒	❒	❒	❒
Manual organization	❒	❒	❒	❒	❒
Illustrations	❒	❒	❒	❒	❒
The manual as a whole	❒	❒	❒	❒	❒

What did you like about the manual?

_____

_____

_____

_____

Error Report

Type of error(s) or problem(s):

- ❒ Incompatibility with product
- ❒ Difficulty in understanding text
- ❒ Regulatory information (Safety, Compliance, Warnings, etc.)
- ❒ Difficulty in finding needed information
- ❒ Missing information
- ❒ Illogical flow of information
- ❒ Style (spelling, grammar, references, etc.)
- ❒ Appearance
- ❒ Other _____

Please list the exact page numbers with the error(s), detail the errors you found (information missing, unclear or inadequately explained, etc.) and attach the page to your fax, if necessary.

_____

_____

_____

_____

Please add any comments or suggestions you may have.

_____

_____

_____

You are:

- ❒ Distributor
- ❒ End user
- ❒ VAR
- ❒ Other

Who is your distributor? _____

Your name and company: _____

Job title: _____

Address: _____

Direct telephone number and extension: _____

Fax number: _____

E-mail: _____

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